ORIGINAL FILE

UNITED STATES GOVERNMENT
MEMORANDUM

DATE: September 20, 1992

SUBJECT: Below 1 GHz LEO Negotiated Rulemaking Advisory Committee

TO: Dockets

Attached are the following documents for inclusion in CC Docket 92-76:

1. LEOAC-0 (Rev.5) - This is the final List of Documents identified by the Committee in its deliberations. Note that documents 37 and 39, the minutes of the last two Committee meetings, are not yet available. They will be added to the docket soon.

2. LEOAC-36 - Minutes of the September 1, 1992 Committee meeting

3. LEOAC-38 - Submissions regarding service availability/spectrum efficiency

4. Report of the Below 1 GHz LEO Negotiated Rulemaking Committee to the Chief, Common Carrier Bureau and cover letter.

List of Documents*

LEOAC-35 Minutes of the August 24, 1992 Committee Meeting
LEOAC-36 Minutes of the September 1, 1992 Committee Meeting
LEOAC-37 Minutes of the September 8, 1992 Committee Meeting
LEOAC-38 Submissions re: service availability/spectrum efficiency
LEOAC-39 Minutes of the September 16, 1992 Committee Meeting

LEOAC-38

Submissions made in connection with
proposals regarding
service availability and spectrum efficiency

Submitted by ORBCOMM

LEOAC-______

Reference : LEOAC-14 : Proposed Service Rules Part 25.401 (b)

Discussion of 75% Service Availability Requirement

As with other congested portions of the spectrum, the UHF and VHF bands are limited resources. Each operating radio system will occupy some of the available spectrum resources. Because of this, it is in the public interest to use the available resources most efficiently. In an analogous fashion, each geostationary FSS system is currently expected to use the entire fixed satellite uplink and downlink allocations. If the Commission licensed an entity to make partial use of the FSS allocations, they would be denying another entity the right to make use of the entire allocation and would, therefore, not be promoting the most efficient use of the orbit-spectrum. For a Little-LEO system, a low service availability is equivalent to a position on the geostationary orbit that is occupied only part of the time.

Low orbit satellites differ from geostationary satellites in that they are in constant motion as seen from the surface of the earth. The percentage of time that a particular satellite is visible to a specific point on the Earth's surface is a function of the orbital parameters of the satellite and the location of interest. In general, for the orbits chosen by the "little"-LEO Applicants, each satellite will be visible to a point in the US between about 6 and 10 % of the time[1]. In order to provide near-continuous coverage to their users, the commercial Little-LEO Applicants propose the use of several satellites per orbital plane and multiple orbital planes. In this manner, the satellites are spread out over the orbital sphere and as one satellite leaves the viability of a user, another satellite will come into view.

While the position of the satellites within an orbital plane will be controlled, because of the small size of satellites, little, if any, on board fuel can be spared to control the precession[2] of the satellite's orbital plane. The uncontrolled precession of the orbital planes[3] means that, at some point in time, the satellites of all of the Little-LEO systems

[1] The Applicants selected circular orbits with altitudes of around 1000 km. The actual visibility statistics will depend on such parameters as the orbit altitude, inclination, ellipticity, minimum usable elevation angle and the latitude of the selected ground point.

[2] Because of forces on the satellites exerted by the sun, moon and non-symmetries in the Earth's gravitation field the satellites will drift both with-in the orbital plane (i.e., changing the satellite-to-satellite phasing) and the satellite planes will rotate (precession) as seen in inertial space. The satellite planes will precess according to the altitude, inclination and physical characteristics of the satellites. These parameters differ between the different Applicants.

[3] Two points should be noted; a) the energy requirements to control the precession of the orbital planes are large relative to the energy required to maintain the proper phase of the satellites within a plane and b)

will be visible to the same service area during the same busy hour. Each Applicant must therefore be prepared to simultaneously share the allocations with all of the other Little-LEO Applicants. When an Applicant with a small percentage of service time is not present, the unused spectrum resources creates an inefficient situation. The most efficient use of the spectrum will occur if all of the Applicants operated over the US the great majority of the time. For this reason, a "figure-of-merit" based on the percentage of available service time was chosen for the Service Rules for the commercial little-LEO systems.

A LEO system comprised of 20 or so satellites will be visible nearly 100% of the time, one satellite at a time[4], to the intended user population. A system of 2 satellites can, at best, be visible about only 20% of the time. Because of the uncontrolled precession of the orbital planes both the 20 satellite system and the 2 satellite systems will take up the same amount of interference budget in a third LEO system. Alternately, the 2 satellite system will occupy a sub-allocation equivalent in size to that of a 20 satellite system. Efficient orbital utilization strongly suggests that, for commercial systems, only high percentage coverage systems should be licensed.

The figure-of-merit of 75% for commercial systems was selected to ensure that efficient use would be made of the UHF/VHF spectrum. A service availability of 100 % is impractical, since the service availability is a non-linear function of the number of satellites for very high percentages, and the cost of obtaining the last few percent of coverage is extremely high. A service availability of lower than 75% was felt to be an inefficient use of spectrum resources potentially blocking the development of high availability systems.

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all of the planes of a given system will precess at the same rate, so the precession has no operational effect with in a system.

[4]A small amount of simultaneous coverage from two or more satellites will occur from time to time, as will small gaps in coverage.

ORBCOMM § 25.401(b) Alternative

ORBCOMM suggested as an alternative to a minimum percentage of time availability the following § 25.401(b) that requires in the application a calculation of service availability:

> In order that the Commission can determine the spectral efficiency of the proposed Non-Voice, Non-Geostationary Satellite Service (< 1 GHz) system, Applicants must include in their application a demonstration of service availability within the United States, measured as a percentage of time during a 24 hour period when service is available averaged over all points within the United States. This should be calculated at the time system deployment for purposes of the certification in § 25.403(a) will occur, along with an estimate of how many months after licensing such certification is expected to occur. For purposes of this provision, service is deemed to be available if there is the potential for a user transceiver to transmit and/or receive a message directly to or from a space station operated as part of the Non-Voice, Non-Geostationary Satellite Service (< 1 GHz) system.

ORBCOMM also provided the Committee with a methodology for calculating the percentage of time availability of service in the U.S., using a computer program based on one-quarter degree by one-quarter degree areas of the country. This approach also allows for weighting of the areas by population.

Submitted by ORBCOMM

Determination of Approximate Service Availability for Non-Voice, Non-Geostationary Mobile Satellites

The approximate service availability of a non-voice, non-geostationary mobile satellite system can be determined from Figure 1 and Figure 2 as follows:

The approximate[1] service availability of a single satellite is obtained by entering Figure 1, on the left hand (Y) axis, with the altitude of the satellite (in km) and drawing a horizontal line to the curve labeled with the inclination of the satellite (extrapolating between inclination curves if necessary). From the junction of the inclination line and the altitude line, drop a vertical to the lower (X) axis. The value read from the lower axis is the approximate percent of time that the single satellite will be visible, averaged over the land mass of the United States.

The value of single satellite service availability, from the discussion of Figure 1 above, is the input to Figure 2 which is used to calculate the figure of merit of total system availability. Enter this value on the left hand (Y) axis and draw a horizontal line over to the curve labeled with the number of satellites in the systems constellation (again, extrapolating between curves if necessary). A vertical line dropped from this point to the lower (X) axis will indicate the approximate service availability of the entire system.

[1]This simple procedure is intended to yield an approximate value of service availability for a non-voice, non-geostationary mobile satellite system, where service is assumed to be available if one of the systems satellites is visible to a point in the U.S. (including CONUS, Alaska and Hawaii). The procedure is not intended to provide an exact value, it is intended to provide a guide to the service availability of a system, in lieu of a specific service availability study provided by an applicant. The actual service availability of a system is a complex function of many factors including spacecraft design and operational considerations that go are beyond the satellite parameters used in this procedure.

Figure 1 - Single Satellite Service Availability

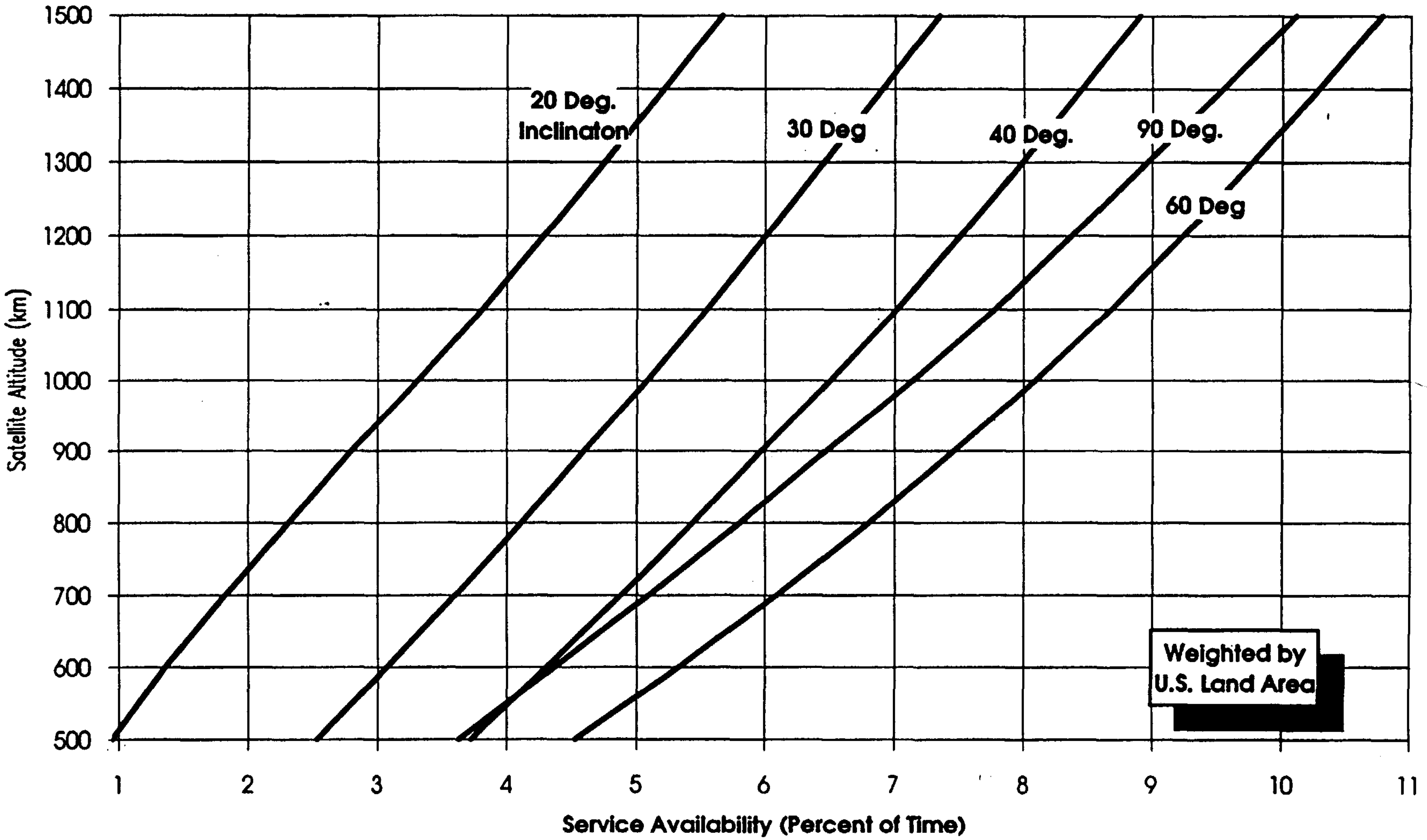


Figure 2 - Constellation Service Availability

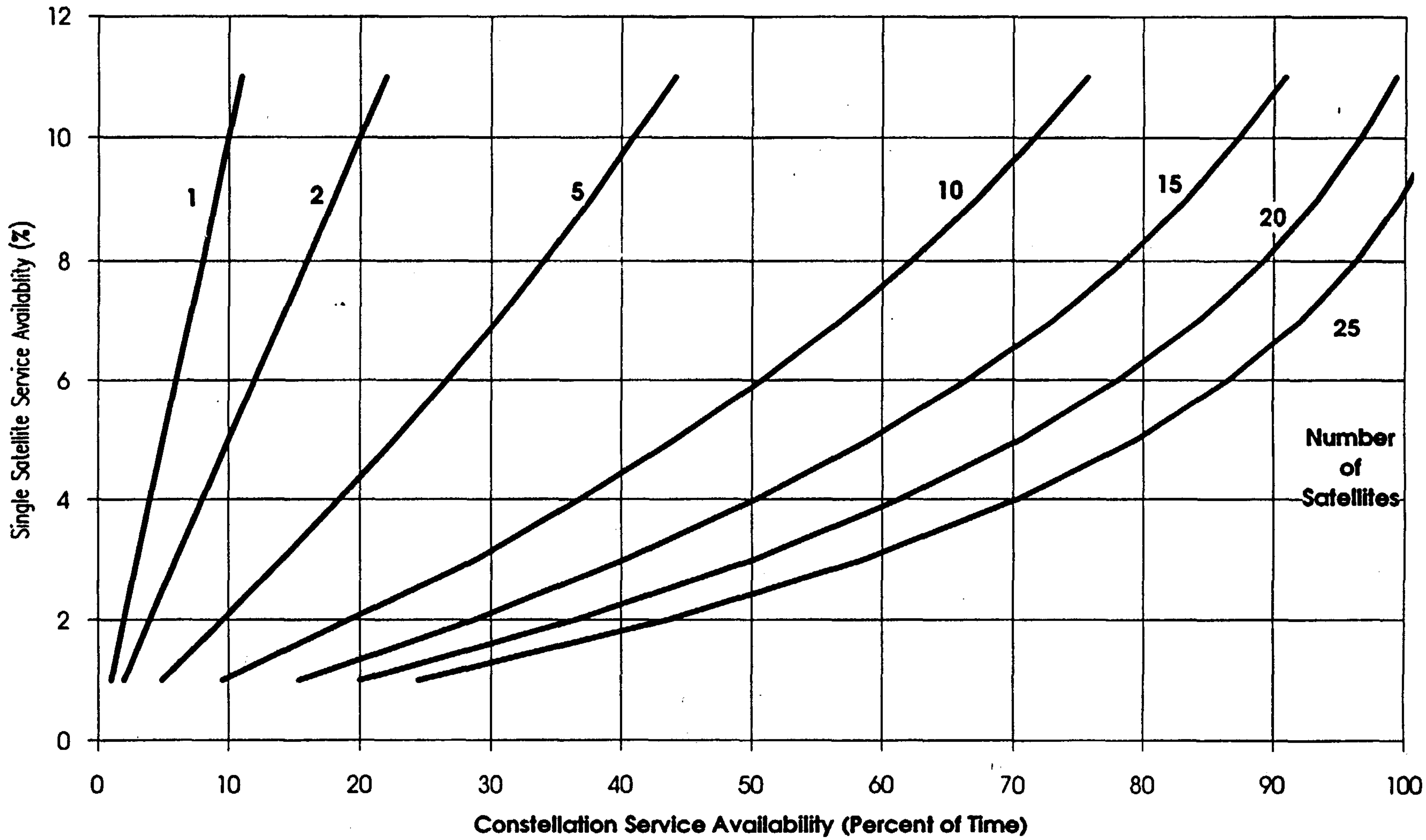
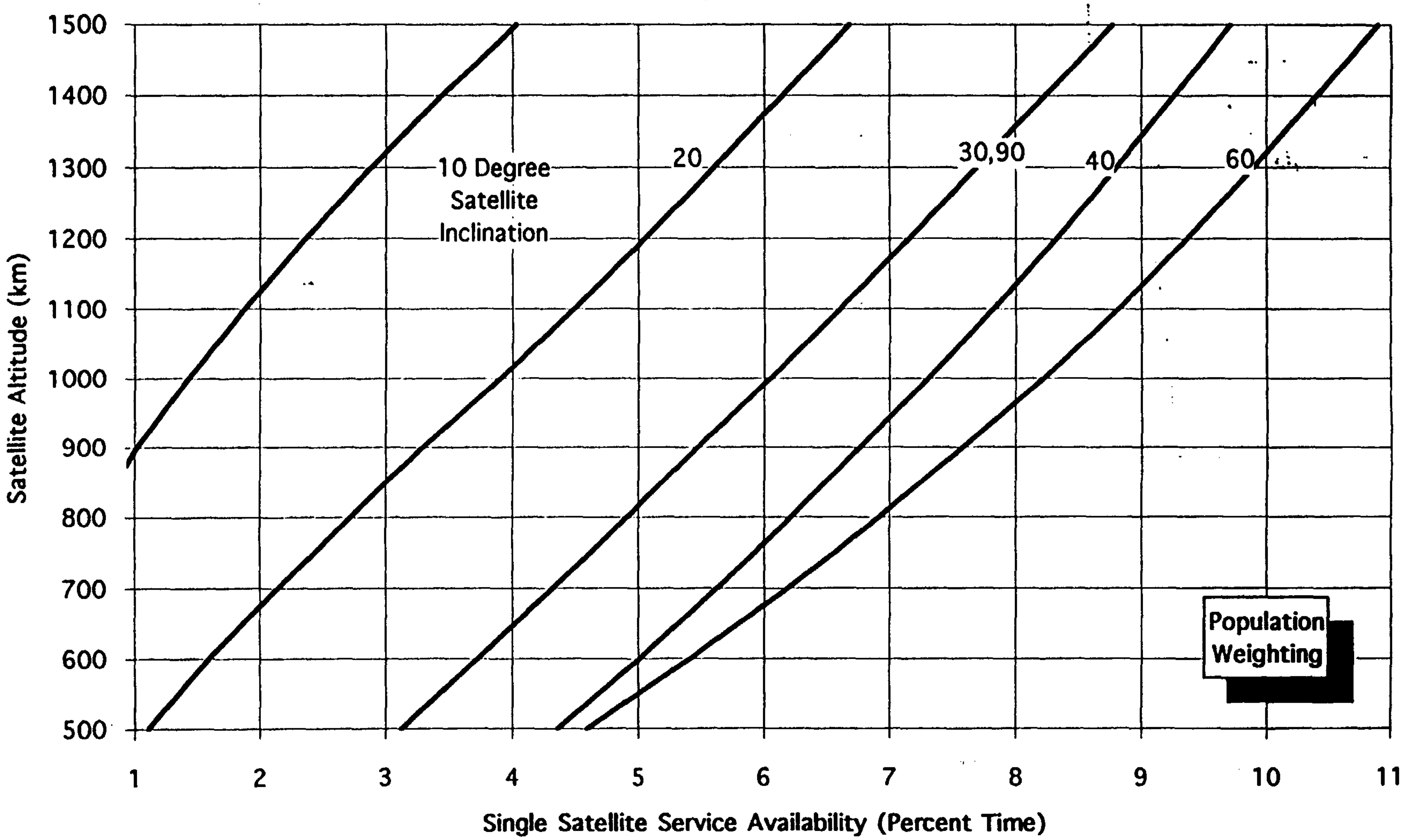


Figure 1 - Constellation Service Availability



Submitted by VITA

9/1/92

LEOAC-___

Efficiency of LEO Systems

Efficient use of the spectrum and orbital resources is clearly an important goal that LEO applicants should undertake to meet. Thus far, the Committee has been presented with one proposed measure of efficiency -- the percentage of time that a satellite in a LEO system will be visible at any point in the U.S. Putting aside how such a percentage should be calculated, such a measure of efficiency is, at most, one of several factors that is relevant to LEO systems that propose to serve the U.S. domestic market for paging-type communications. It is not, however, the only relevant measure of efficiency that need be considered, nor for some systems may it be relevant at all. Other factors of equal or greater importance in evaluating efficiency of service include the following:

1. How much spectrum will the system occupy? What is the preclusive effect of the system upon other potential users? Will the system require other systems to be modified to be compatible with it, or can it coexist with other system designs?

2. What geographic service area is proposed for the system: U.S. domestic, regional, international?

3. What communications needs will the system serve and how much of the time will the system be employed, both in terms of frequency and length of use? Will the system be used for paging-type messages, electronic mail, general data communications needs, etc.? Moreover, are there other terrestrial or satellite-

based communications systems serving and intended to serve the same needs?

4. How much will the system cost to use? How will the cost be affected by the use of various design options? How cost-sensitive is the intended market?

5. How feasible is the design, financing, and implementation schedule of the system?

All of these factors focus on the ultimate question of whether the proposed system represents an efficient, cost effective, and technically and economically viable response that serves identifiable communications needs. The Commission has recognized with respect to other satellite services that a determination of spectrum/orbital efficiency necessarily involves the consideration of a variety of factors and that the matter requires individual case-by-case evaluation. The same is true with respect to LEO systems.

Accordingly, VITA suggests that the Committee adopt a rule that will require each applicant to make a showing of spectrum/orbital efficiency, based upon its own service plans and its identified customer base.

A proposed rule along these lines is as follows:

§ 25.401(b) Applicants shall include in their applications a showing that their system represents an efficient use of spectrum and orbital resources. Such a showing may take into account the proposed service area, service requirements, and nature of their contemplated customer base, availability of the service, timing of implementation, amount of spectrum employed, the preclusive effect of the system on other potential systems, cost and other factors, as appropriate.

UNITED STATES GOVERNMENT
MEMORANDUM

DATE: August 31, 1992

TO: Tom Tycz
Cecily Holiday
Kris Kendall

FROM: Harry Ng

SUBJECT: LEO Satellite Orbital Management

The objective of this memo is to assess the impact of LEO satellite station-keeping on the percentage of time a LEO satellite constellation is visible to a point on the surface of the Earth. The visibility time could be translated into efficient use of the orbit/spectrum resource, service availability and, subsequently, how the public interests are being served.

The result indicates that the visibility time decreases if the LEO satellites are not being kept at their assigned position in the constellation.

Analysis

A LEO satellite system, by nature, is a dynamic and orderly ensemble within which every satellite has a predefined position in the constellation; and the constellation moves in unison above the Earth. Consequently, within one orbital period, every satellite in the constellation would have traversed the Earth once. Due to the constant motion of the satellites relative to the ground, each satellite would only be visible for a short time to a point on the surface of the Earth. However, since there are many succeeding satellites in a typical constellation, a person on the ground could continuously be visible to at least one LEO satellite in the constellation.

The percentage of time a LEO satellite constellation is visible to a point on the ground depends on the number of LEO satellites in each orbital planes, the number of orbital planes in the constellation and the orbit altitude and inclination angle. Table 1 gives the percentage of time that a LEO satellite constellation is visible at a particular point on the surface of the Earth. The LEO constellation used in the example has three evenly spaced orbital planes at 120 degrees apart; each orbital plane has six evenly spaced satellites at 60 degrees apart; the orbital inclination angle is 45 degrees; and the orbital altitude is 960 km. The example indicates that the LEO satellite constellation is not visible to any point north or south of 75 degrees latitude. The example also indicates that the LEO constellation is visible at least 97.1% of the time in an open field around Washington, D.C. area.

The above example assumes that the satellites are being kept fixed at their relative position in the constellation. However, in the actual space environment, the position of each satellite in the constellation would be influenced by the sun, moon, non-spherical-non-homogeneous Earth, and solar wind. Hence, the position of the satellite will be affected in addition to the nodal regression. The exact impact on the satellite orbital position is unknown at this point. However, the consequence of uncontrolled satellite positions can be quantified. Using the same number of LEO satellites, Tables 2 to 9 show the percentage of time the LEO constellation is visible to a point on the ground for various orbital plan separations and satellite separations. The following table summarized the result for the Washington, D.C. area.

		LEO satellite separation (deg.) in each orbital plan		
		60	50	40
Orbital Plane Separation (deg.)	120	97.1%	92.3%	80.1%
	100	95.5%	90.9%	78.8%
	80	89.7%	83.8%	72.7%

The result indicates that the change in the percentage of time is large for large deviation of the satellite positions relative to the symmetrical constellation (i.e, Table 1, the 120/60 degrees case). Therefore, it seems prudent to maintain each LEO satellite in the constellation to its assigned position throughout the life span of the satellite. The assigned position could be a cube in the constellation space with a finite dimension of, for example, [ ] degrees on each side. This LEO satellite station-keeping tolerance should be verified by the experimental LEO satellites that we authorized recently.

Table 1

Orbital Plan Separation ......: 120 deg.
LEO Satellite Separation .....: 60 deg.

The name of the LEO system...................: LEOTELCOM-120-60
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point			Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees)							
Name	Lat (N)	Long (EL)	No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	4.0	96.0	86.9	69.9	56.0	45.3	35.7
New York, NY	41.0	286.0	3.1	96.9	88.2	76.1	62.3	49.6	39.7
Washington, DC	39.0	283.0	2.9	97.1	88.6	76.9	63.5	50.6	41.6
Key West, FL	25.0	278.0	5.4	94.6	82.2	62.7	41.5	29.1	21.2
Puerto Rico	18.0	294.0	13.3	86.7	60.0	43.9	33.0	24.3	18.4
Seattle, WASH	48.0	237.0	4.7	95.3	81.9	65.1	50.2	38.4	29.5
San Francisco	38.0	237.0	2.6	97.4	89.4	78.1	65.1	51.9	41.6
San Diego	33.0	243.0	2.3	97.7	88.5	77.0	63.5	50.7	38.4
North Alaska	70.0	210.0	66.9	33.1	0.0	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	28.7	71.3	43.8	21.2	4.5	0.0	0.0
Hawaii	20.0	205.0	9.8	90.2	67.8	46.2	33.6	24.3	18.0
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.0	33.0	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	39.5	60.5	29.4	6.1	0.0	0.0	0.0
Test-point 60	60.0	260.0	22.1	77.9	52.5	30.0	13.5	1.0	0.0
Test-point 55	55.0	260.0	11.9	88.1	68.2	48.9	32.2	20.2	10.8
Test-point 50	50.0	260.0	5.7	94.3	77.8	61.4	46.2	34.3	25.3
Test-point 45	45.0	260.0	4.0	96.0	85.1	70.8	56.5	43.6	35.9
Test-point 40	40.0	260.0	3.0	97.0	89.0	76.1	62.9	50.8	40.4
Test-point 35	35.0	260.0	2.5	97.5	89.3	77.5	63.9	51.7	41.1
Test-point 30	30.0	260.0	3.2	96.8	87.1	74.1	58.3	43.2	29.9
Test-point 275	27.5	260.0	4.1	95.9	85.4	70.2	51.7	34.8	25.5
Test-point 25	25.0	260.0	5.2	94.8	82.1	63.5	42.5	30.5	22.2
Test-point 225	22.5	260.0	7.2	92.8	77.0	51.7	37.0	26.8	19.2
Test-point 20	20.0	260.0	9.8	90.2	67.4	45.7	33.1	24.4	18.0
Test-point 175	17.5	260.0	13.3	86.7	60.7	45.5	34.0	25.7	18.5
Test-point 15	15.0	260.0	18.8	81.2	62.3	47.0	35.4	26.6	20.0
Test-point 125	12.5	260.0	17.7	82.3	65.2	49.1	36.3	27.4	20.9
Test-point 10	10.0	260.0	15.2	84.8	68.0	51.5	38.3	28.4	21.3
Test-point 075	7.5	260.0	12.8	87.2	70.2	53.3	39.3	29.2	21.5
Test-point 5	5.0	260.0	11.7	88.3	72.7	54.9	40.3	29.0	21.3
Test-point 025	2.5	260.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Table 2

Orbital Plan Separation ......: 120 deg.
LEO Satellite Separation .....: 50 deg.

The name of the LEO ststem...................: LEOTELCOM-120-50
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point Name	Lat (N)	Long (EL)	Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees): No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	9.7	90.3	85.2	72.1	57.7	46.2	36.0
New York, NY	41.0	286.0	8.1	91.9	87.1	76.2	62.5	50.8	40.6
Washington, DC	39.0	283.0	7.7	92.3	87.8	76.6	62.6	50.8	42.5
Key West, FL	25.0	278.0	4.2	95.8	83.6	64.5	43.1	30.7	22.1
Puerto Rico	18.0	294.0	10.0	90.0	65.1	49.3	38.2	29.4	22.8
Seattle, WASH	48.0	237.0	10.7	89.3	83.2	67.7	51.3	38.7	29.5
San Francisco	38.0	237.0	6.9	93.1	88.9	77.9	63.6	51.7	42.2
San Diego	33.0	243.0	5.6	94.4	89.6	75.9	61.7	48.7	36.9
North Alaska	70.0	210.0	66.8	33.2	0.0	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	28.4	71.6	43.8	21.3	4.5	0.0	0.0
Hawaii	20.0	205.0	7.5	92.5	72.3	52.2	39.7	30.2	23.1
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.1	32.9	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	39.5	60.5	29.2	6.0	0.0	0.0	0.0
Test-point 60	60.0	260.0	23.2	76.8	52.4	29.8	13.4	1.0	0.0
Test-point 55	55.0	260.0	15.8	84.2	70.5	49.1	32.1	20.0	10.7
Test-point 50	50.0	260.0	12.3	87.7	80.7	63.0	46.6	34.2	25.1
Test-point 45	45.0	260.0	9.5	90.5	84.8	73.0	58.1	44.4	36.2
Test-point 40	40.0	260.0	7.7	92.3	87.8	76.3	62.5	51.6	41.5
Test-point 35	35.0	260.0	6.4	93.6	89.3	77.0	62.2	50.2	40.3
Test-point 30	30.0	260.0	5.3	94.7	88.3	73.4	57.4	42.0	28.6
Test-point 275	27.5	260.0	4.8	95.2	86.5	70.6	51.8	34.4	25.0
Test-point 25	25.0	260.0	4.3	95.7	83.4	65.5	44.5	31.8	23.3
Test-point 225	22.5	260.0	5.2	94.8	79.8	55.5	40.9	30.8	23.1
Test-point 20	20.0	260.0	7.4	92.6	72.3	52.0	39.6	30.7	23.2
Test-point 175	17.5	260.0	10.0	90.0	66.0	50.7	39.4	30.8	22.8
Test-point 15	15.0	260.0	16.8	83.2	64.6	50.7	39.4	30.5	22.8
Test-point 125	12.5	260.0	19.1	80.9	65.6	51.5	39.3	29.4	22.1
Test-point 10	10.0	260.0	18.7	81.3	67.5	52.9	39.4	28.9	21.6
Test-point 075	7.5	260.0	18.4	81.6	68.8	53.6	39.1	28.9	21.5
Test-point 5	5.0	260.0	18.2	81.8	69.6	54.0	39.4	28.8	21.3
Test-point 025	2.5	260.0	17.4	82.6	69.7	53.5	39.3	28.8	21.5
Test-point 0	0.0	260.0	17.5	82.5	69.5	54.3	40.4	28.9	21.1

Table 3

Orbital Plan Separation ......: 120 deg.
LEO Satellite Separation .....: 40 deg.

The name of the LEO ststem...................: LEOTELCOM-120-40
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point			Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees)							
Name	Lat (N)	Long (EL)	No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	23.2	76.8	71.4	64.9	56.8	46.1	35.9
New York, NY	41.0	286.0	20.8	79.2	73.3	68.0	62.4	50.6	40.5
Washington, DC	39.0	283.0	19.9	80.1	74.2	69.2	63.3	51.6	42.8
Key West, FL	25.0	278.0	13.2	86.8	79.4	63.6	43.4	30.4	21.7
Puerto Rico	18.0	294.0	13.4	86.6	60.8	46.5	36.0	26.4	19.8
Seattle, WASH	48.0	237.0	24.3	75.7	69.7	62.2	51.3	38.7	29.5
San Francisco	38.0	237.0	18.9	81.1	75.5	70.5	64.5	53.0	42.8
San Diego	33.0	243.0	16.6	83.4	77.6	72.4	63.5	51.4	39.4
North Alaska	70.0	210.0	66.7	33.3	0.0	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	36.1	63.9	43.6	21.3	4.5	0.0	0.0
Hawaii	20.0	205.0	11.2	88.8	68.7	49.3	36.8	26.4	19.6
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.1	32.9	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	44.1	55.9	29.2	6.0	0.0	0.0	0.0
Test-point 60	60.0	260.0	33.2	66.8	50.7	29.8	13.4	1.0	0.0
Test-point 55	55.0	260.0	29.2	70.8	62.6	48.8	32.1	20.0	10.7
Test-point 50	50.0	260.0	25.8	74.2	68.0	59.7	46.6	34.2	25.1
Test-point 45	45.0	260.0	22.8	77.2	71.2	65.5	57.5	44.5	36.2
Test-point 40	40.0	260.0	20.1	79.9	74.2	68.9	63.0	51.9	41.6
Test-point 35	35.0	260.0	17.8	82.2	76.6	71.4	63.6	52.4	42.4
Test-point 30	30.0	260.0	15.5	84.5	78.8	71.5	59.1	44.4	30.8
Test-point 275	27.5	260.0	14.3	85.7	79.8	69.5	53.2	36.1	26.2
Test-point 25	25.0	260.0	13.0	87.0	79.3	64.6	44.6	31.9	22.7
Test-point 225	22.5	260.0	11.9	88.1	76.6	54.2	39.5	28.0	20.0
Test-point 20	20.0	260.0	11.1	88.9	68.8	49.3	36.8	27.1	19.8
Test-point 175	17.5	260.0	13.3	86.7	61.7	48.4	37.2	28.0	20.1
Test-point 15	15.0	260.0	21.0	79.0	60.8	48.3	37.8	28.5	21.2
Test-point 125	12.5	260.0	23.8	76.2	61.2	48.9	37.9	28.7	21.6
Test-point 10	10.0	260.0	24.4	75.6	61.8	49.8	39.0	29.1	21.7
Test-point 075	7.5	260.0	24.9	75.1	62.1	50.4	39.6	29.4	21.5
Test-point 5	5.0	260.0	25.7	74.3	62.3	51.2	40.2	29.0	21.3
Test-point 025	2.5	260.0	25.4	74.6	62.6	51.6	39.6	28.8	21.5
Test-point 0	0.0	260.0	26.1	73.9	62.4	52.1	40.5	28.9	21.1

Table 4

Orbital Plan Separation ......: 100 deg.
LEO Satellite Separation .....: 60 deg.

The name of the LEO ststem...................: LEOTELCOM-100-60
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point Name	Lat (N)	Long (EL)	Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees) No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	5.8	94.2	81.4	65.4	53.1	43.0	34.9
New York, NY	41.0	286.0	4.8	95.2	84.3	70.1	57.9	47.3	39.3
Washington, DC	39.0	283.0	4.5	95.5	85.1	71.8	59.1	49.2	40.8
Key West, FL	25.0	278.0	4.8	95.2	83.3	67.8	48.6	34.6	25.0
Puerto Rico	18.0	294.0	7.6	92.4	73.0	54.6	40.4	28.6	21.8
Seattle, WASH	48.0	237.0	6.7	93.3	77.1	61.4	49.4	39.1	30.3
San Francisco	38.0	237.0	4.2	95.8	85.7	72.9	60.4	49.4	40.8
San Diego	33.0	243.0	3.5	96.5	85.5	73.3	61.3	49.2	38.7
North Alaska	70.0	210.0	67.4	32.6	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	30.4	69.6	43.8	20.4	4.5	0.0	0.0
Hawaii	20.0	205.0	6.2	93.8	77.2	57.8	42.9	32.3	24.3
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	66.1	33.9	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	40.1	59.9	30.2	6.4	0.0	0.0	0.0
Test-point 60	60.0	260.0	24.9	75.1	51.7	30.6	13.8	0.9	0.0
Test-point 55	55.0	260.0	14.9	85.1	64.6	47.9	33.0	20.5	10.9
Test-point 50	50.0	260.0	8.7	91.3	73.7	58.4	45.3	35.3	25.7
Test-point 45	45.0	260.0	5.7	94.3	80.4	65.7	53.3	43.6	35.2
Test-point 40	40.0	260.0	4.7	95.3	84.8	71.3	59.1	48.6	40.1
Test-point 35	35.0	260.0	3.9	96.1	85.1	73.2	61.4	49.9	40.5
Test-point 30	30.0	260.0	4.0	96.0	84.7	71.7	58.8	45.0	31.4
Test-point 275	27.5	260.0	4.5	95.5	84.8	70.7	54.8	37.9	28.0
Test-point 25	25.0	260.0	4.7	95.3	84.0	67.7	48.0	34.3	26.0
Test-point 225	22.5	260.0	5.7	94.3	82.0	60.1	43.3	31.6	23.5
Test-point 20	20.0	260.0	6.5	93.5	77.1	57.0	40.9	30.4	22.0
Test-point 175	17.5	260.0	7.9	92.1	71.0	53.6	39.5	29.3	21.7
Test-point 15	15.0	260.0	12.7	87.3	68.0	51.8	39.1	28.9	21.6
Test-point 125	12.5	260.0	15.3	84.7	67.2	50.7	38.6	28.8	21.6
Test-point 10	10.0	260.0	15.7	84.3	65.8	50.0	38.2	28.7	20.8
Test-point 075	7.5	260.0	16.3	83.7	65.5	50.4	37.1	27.1	20.5
Test-point 5	5.0	260.0	16.7	83.3	65.1	49.1	36.3	26.3	19.2
Test-point 025	2.5	260.0	16.8	83.2	64.8	48.4	35.3	25.2	18.5
Test-point 0	0.0	260.0	17.3	82.7	64.8	47.8	34.6	24.6	18.0

Table 5

Orbital Plan Separation ......: 100 deg.
LEO Satellite Separation .....: 50 deg.

The name of the LEO ststem...................: LEOTELCOM-100-50
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point Name	Lat (N)	Long (EL)	Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees): No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	11.9	88.1	80.9	69.0	56.4	44.7	35.4
New York, NY	41.0	286.0	9.8	90.2	83.3	73.0	61.4	50.1	40.7
Washington, DC	39.0	283.0	9.1	90.9	85.0	74.1	62.0	51.8	42.5
Key West, FL	25.0	278.0	5.9	94.1	84.9	65.5	43.0	30.5	21.9
Puerto Rico	18.0	294.0	8.6	91.4	72.0	53.4	39.4	28.7	22.0
Seattle, WASH	48.0	237.0	13.6	86.4	77.8	64.8	51.5	39.7	30.2
San Francisco	38.0	237.0	8.5	91.5	85.8	74.7	63.0	51.6	42.2
San Diego	33.0	243.0	7.0	93.0	88.1	75.5	62.3	48.9	38.0
North Alaska	70.0	210.0	67.5	32.5	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	32.0	68.0	43.8	20.3	4.5	0.0	0.0
Hawaii	20.0	205.0	7.0	93.0	75.6	55.4	41.0	31.1	23.4
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	66.1	33.9	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	41.1	58.9	30.2	6.4	0.0	0.0	0.0
Test-point 60	60.0	260.0	27.4	72.6	51.5	30.6	13.8	0.9	0.0
Test-point 55	55.0	260.0	20.9	79.1	65.7	48.2	32.9	20.5	10.9
Test-point 50	50.0	260.0	15.6	84.4	75.2	60.6	46.5	35.4	25.7
Test-point 45	45.0	260.0	12.1	87.9	79.9	69.1	56.4	45.1	35.5
Test-point 40	40.0	260.0	9.3	90.7	84.2	73.7	62.0	51.5	41.7
Test-point 35	35.0	260.0	7.6	92.4	87.2	75.1	62.8	51.2	40.6
Test-point 30	30.0	260.0	6.5	93.5	87.8	73.9	58.2	42.0	28.3
Test-point 275	27.5	260.0	6.1	93.9	87.0	71.9	51.4	33.2	24.1
Test-point 25	25.0	260.0	5.6	94.4	85.6	65.9	42.6	30.1	22.7
Test-point 225	22.5	260.0	6.2	93.8	81.3	56.0	39.6	29.1	22.0
Test-point 20	20.0	260.0	6.8	93.2	75.2	54.6	39.2	29.3	21.7
Test-point 175	17.5	260.0	9.1	90.9	69.9	52.8	39.0	29.0	22.0
Test-point 15	15.0	260.0	13.9	86.1	67.6	52.0	38.8	29.0	21.8
Test-point 125	12.5	260.0	18.2	81.8	66.8	51.3	38.8	28.8	21.5
Test-point 10	10.0	260.0	19.5	80.5	65.7	50.8	38.6	28.9	20.8
Test-point 075	7.5	260.0	20.4	79.6	66.0	51.3	37.9	27.9	21.0
Test-point 5	5.0	260.0	20.5	79.5	65.9	50.5	37.7	27.7	20.5
Test-point 025	2.5	260.0	19.8	80.2	66.0	50.4	37.3	27.4	20.5
Test-point 0	0.0	260.0	20.2	79.8	66.4	50.3	37.0	27.4	20.3

Table 6

Orbital Plan Separation ......: 100 deg.
LEO Satellite Separation .....: 40 deg.

The name of the LEO ststem...................: ELOTELCOM-100-40
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point Name	Lat (N)	Long (EL)	Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees) No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	24.9	75.1	69.2	61.9	54.7	43.6	35.1
New York, NY	41.0	286.0	22.5	77.5	71.2	65.3	58.9	47.5	39.1
Washington, DC	39.0	283.0	21.2	78.8	72.7	66.5	59.5	48.9	40.1
Key West, FL	25.0	278.0	15.8	84.2	77.7	64.1	45.9	33.2	24.3
Puerto Rico	18.0	294.0	15.2	84.8	67.5	53.1	41.5	29.8	22.7
Seattle, WASH	48.0	237.0	26.2	73.8	66.5	59.5	51.1	39.7	30.2
San Francisco	38.0	237.0	20.5	79.5	73.3	67.6	60.4	48.7	39.6
San Diego	33.0	243.0	18.1	81.9	75.8	70.5	59.9	47.4	36.7
North Alaska	70.0	210.0	67.4	32.6	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	40.5	59.5	43.7	20.3	4.5	0.0	0.0
Hawaii	20.0	205.0	14.4	85.6	70.6	54.9	43.5	33.3	25.0
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	66.0	34.0	0.1	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	45.9	54.1	30.2	6.4	0.0	0.0	0.0
Test-point 60	60.0	260.0	37.8	62.2	50.3	30.7	13.8	0.9	0.0
Test-point 55	55.0	260.0	32.9	67.1	58.8	48.6	33.0	20.6	10.9
Test-point 50	50.0	260.0	28.4	71.6	64.2	57.3	46.5	35.4	25.8
Test-point 45	45.0	260.0	24.5	75.5	68.2	62.3	54.9	44.1	35.5
Test-point 40	40.0	260.0	21.8	78.2	72.1	65.9	59.6	48.5	39.8
Test-point 35	35.0	260.0	19.0	81.0	74.8	69.1	60.1	48.4	38.4
Test-point 30	30.0	260.0	17.1	82.9	77.1	69.4	57.0	41.7	28.8
Test-point 275	27.5	260.0	16.2	83.8	78.1	68.1	52.0	34.9	25.9
Test-point 25	25.0	260.0	15.5	84.5	78.3	64.1	45.2	32.8	25.6
Test-point 225	22.5	260.0	14.9	85.1	76.0	56.0	42.6	31.7	24.2
Test-point 20	20.0	260.0	14.3	85.7	70.9	54.4	41.6	31.7	22.9
Test-point 175	17.5	260.0	15.5	84.5	65.7	52.8	41.3	30.5	22.7
Test-point 15	15.0	260.0	19.3	80.7	63.6	51.5	40.3	29.7	22.3
Test-point 125	12.5	260.0	23.4	76.6	62.6	51.0	40.1	29.4	21.7
Test-point 10	10.0	260.0	24.4	75.6	61.3	50.0	39.7	29.5	21.0
Test-point 075	7.5	260.0	25.5	74.5	61.4	50.5	38.9	28.2	21.1
Test-point 5	5.0	260.0	25.9	74.1	60.9	49.7	38.6	28.1	20.5
Test-point 025	2.5	260.0	25.7	74.3	61.6	49.5	38.0	27.6	20.6
Test-point 0	0.0	260.0	26.7	73.3	62.2	49.4	37.7	27.5	20.3

Table 7

Orbital Plan Separation ......: 80 deg.
LEO SAtellite Separation .....: 60 deg.

The name of the LEO ststem...................: LEOTELCOM- 80-60
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point			Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees)						
Name	Lat (N)	Long (EL)	No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	13.6	86.4	73.2	58.8	48.4	39.3	32.4
New York, NY	41.0	286.0	11.1	88.9	76.1	61.5	50.4	41.3	34.8
Washington, DC	39.0	283.0	10.3	89.7	76.7	62.2	50.8	42.0	34.7
Key West, FL	25.0	278.0	5.9	94.1	81.6	65.8	48.9	35.1	26.3
Puerto Rico	18.0	294.0	8.5	91.5	78.2	60.7	42.2	30.4	21.4
Seattle, WASH	48.0	237.0	14.8	85.2	70.6	56.1	46.0	36.8	28.6
San Francisco	38.0	237.0	9.5	90.5	78.4	64.4	52.4	43.0	35.0
San Diego	33.0	243.0	7.3	92.7	79.8	65.9	53.7	43.3	34.2
North Alaska	70.0	210.0	66.7	33.3	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	33.2	66.8	44.1	21.6	4.6	0.0	0.0
Hawaii	20.0	205.0	7.8	92.2	78.8	61.2	45.8	32.8	24.5
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.4	32.6	0.2	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	41.9	58.1	28.8	5.6	0.0	0.0	0.0
Test-point 60	60.0	260.0	30.1	69.9	49.2	29.3	12.9	1.2	0.0
Test-point 55	55.0	260.0	22.4	77.6	61.4	45.0	31.0	19.7	10.5
Test-point 50	50.0	260.0	17.1	82.9	68.3	53.6	42.0	32.3	24.6
Test-point 45	45.0	260.0	12.8	87.2	73.0	58.9	47.8	39.5	32.0
Test-point 40	40.0	260.0	10.6	89.4	76.9	62.6	51.5	42.2	35.1
Test-point 35	35.0	260.0	8.5	91.5	79.9	65.5	53.2	43.0	35.1
Test-point 30	30.0	260.0	7.0	93.0	80.9	66.9	53.4	40.5	29.3
Test-point 275	27.5	260.0	6.4	93.6	80.7	67.0	52.0	37.9	27.9
Test-point 25	25.0	260.0	6.0	94.0	80.5	65.3	50.0	36.2	26.0
Test-point 225	22.5	260.0	6.7	93.3	79.7	63.6	47.5	33.7	25.2
Test-point 20	20.0	260.0	7.8	92.2	78.1	61.1	43.9	33.2	24.0
Test-point 175	17.5	260.0	8.8	91.2	77.5	59.3	42.9	31.7	23.3
Test-point 15	15.0	260.0	9.9	90.1	75.5	55.5	41.2	30.3	22.5
Test-point 125	12.5	260.0	10.1	89.9	72.9	54.2	40.1	28.7	21.1
Test-point 10	10.0	260.0	10.7	89.3	71.1	52.7	37.6	27.5	20.5
Test-point 075	7.5	260.0	11.6	88.4	69.0	51.3	36.3	26.3	18.7
Test-point 5	5.0	260.0	12.9	87.1	67.9	48.5	34.8	24.9	18.9
Test-point 025	2.5	260.0	14.5	85.5	66.0	47.3	33.9	24.7	18.5
Test-point 0	0.0	260.0	15.1	84.9	64.1	47.4	33.9	24.7	18.1

Table 8

Orbital Plan Separation ......: 80 deg.
LEO Satellite Separation .....: 50 deg.

The name of the LEO system...................: LEOTELCOM- 80-50
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point			Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees)							
Name	Lat (N)	Long (EL)	No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	20.0	80.0	72.4	61.0	50.0	40.4	33.4
New York, NY	41.0	286.0	17.4	82.6	75.8	65.3	54.6	44.7	37.5
Washington, DC	39.0	283.0	16.2	83.8	76.4	66.0	55.5	46.3	38.4
Key West, FL	25.0	278.0	10.0	90.0	82.6	69.3	50.6	35.7	26.5
Puerto Rico	18.0	294.0	9.9	90.1	77.5	58.6	42.0	30.9	21.9
Seattle, WASH	48.0	237.0	21.4	78.6	69.7	56.9	46.2	36.7	28.8
San Francisco	38.0	237.0	15.6	84.4	78.2	68.4	57.0	47.4	38.4
San Diego	33.0	243.0	13.0	87.0	80.2	69.9	59.4	48.4	39.0
North Alaska	70.0	210.0	66.8	33.2	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	37.3	62.7	42.4	21.6	4.6	0.0	0.0
Hawaii	20.0	205.0	9.4	90.6	79.7	60.0	45.2	33.2	24.9
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.4	32.6	0.2	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	44.8	55.2	28.9	5.6	0.0	0.0	0.0
Test-point 60	60.0	260.0	35.1	64.9	47.1	29.2	13.0	1.2	0.0
Test-point 55	55.0	260.0	28.8	71.2	59.9	43.8	30.6	19.8	10.6
Test-point 50	50.0	260.0	23.4	76.6	67.2	53.7	41.8	32.1	24.5
Test-point 45	45.0	260.0	19.1	80.9	72.2	61.3	49.3	40.4	32.7
Test-point 40	40.0	260.0	16.8	83.2	76.5	66.5	55.9	45.8	38.3
Test-point 35	35.0	260.0	14.4	85.6	79.6	69.0	57.9	48.1	39.5
Test-point 30	30.0	260.0	12.2	87.8	81.6	70.8	58.5	45.1	32.2
Test-point 275	27.5	260.0	11.4	88.6	81.8	70.8	56.6	40.4	28.7
Test-point 25	25.0	260.0	10.2	89.8	81.5	68.8	51.5	36.6	26.2
Test-point 225	22.5	260.0	9.7	90.3	81.3	64.0	47.0	34.0	25.6
Test-point 20	20.0	260.0	9.6	90.4	78.9	60.0	43.5	33.5	24.4
Test-point 175	17.5	260.0	10.1	89.9	76.9	57.5	42.7	31.8	23.6
Test-point 15	15.0	260.0	11.7	88.3	73.5	55.2	41.0	30.3	22.4
Test-point 125	12.5	260.0	12.3	87.7	71.3	54.3	39.9	28.5	20.9
Test-point 10	10.0	260.0	13.9	86.1	70.4	52.5	37.6	27.6	20.4
Test-point 075	7.5	260.0	14.8	85.2	68.9	51.9	36.8	27.0	19.1
Test-point 5	5.0	260.0	15.2	84.8	68.4	49.8	36.1	26.1	20.0
Test-point 025	2.5	260.0	16.0	84.0	67.2	49.4	35.9	26.8	20.2
Test-point 0	0.0	260.0	16.5	83.5	65.8	49.7	36.2	27.2	20.2

Table 9

Orbital Plan Separation ......: 80 deg.
LEO Satellite Separation .....: 40 deg.

The name of the LEO system...................: LEOTELCOM- 80-40
Orbital elements: The number of orbital plans.: 3
The number of LEOs per plan.: 6
The inclination angle (deg).: 45.0
The orbital altitude (km)...: 960.0
The interval of computation & sample (min.)...: 5700.0 1.0

LEO SYSTEM VISIBILITY AT A SPECIFIC TEST-POINT

Test-Point Name	Lat (N)	Long (EL)	Percentage of time the LEO system is visible to the test-point at or above the elevation angle (degrees) No LEO	0.	5.	10.	15.	20.	25.
Maine	45.0	293.0	31.6	68.4	62.1	55.3	50.1	41.7	35.2
New York, NY	41.0	286.0	28.8	71.2	65.3	59.0	53.1	45.2	38.9
Washington, DC	39.0	283.0	27.3	72.7	66.0	59.5	53.7	45.8	39.1
Key West, FL	25.0	278.0	20.3	79.7	74.5	64.1	48.7	34.2	25.9
Puerto Rico	18.0	294.0	18.6	81.4	70.9	57.1	43.2	31.5	22.4
Seattle, WASH	48.0	237.0	33.0	67.0	59.4	53.0	47.3	38.5	29.9
San Francisco	38.0	237.0	27.1	72.9	67.6	61.6	55.2	46.6	38.8
San Diego	33.0	243.0	23.8	76.2	69.6	64.1	57.0	45.8	35.8
North Alaska	70.0	210.0	67.1	32.9	0.1	0.0	0.0	0.0	0.0
Anchorage	62.0	210.0	46.6	53.4	41.4	21.6	4.6	0.0	0.0
Hawaii	20.0	205.0	18.4	81.6	72.3	57.8	46.4	34.1	25.5
Test-point 80	80.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 75	75.0	260.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Test-point 70	70.0	260.0	67.6	32.4	0.2	0.0	0.0	0.0	0.0
Test-point 65	65.0	260.0	51.0	49.0	28.9	5.6	0.0	0.0	0.0
Test-point 60	60.0	260.0	44.6	55.4	45.3	29.0	13.0	1.2	0.0
Test-point 55	55.0	260.0	39.5	60.5	52.7	44.1	31.0	19.8	10.6
Test-point 50	50.0	260.0	34.8	65.2	57.6	50.9	43.0	33.2	25.0
Test-point 45	45.0	260.0	30.7	69.3	61.8	55.9	49.6	42.3	34.6
Test-point 40	40.0	260.0	28.3	71.7	65.9	59.8	54.3	45.8	39.2
Test-point 35	35.0	260.0	25.6	74.4	69.1	63.5	55.9	46.2	37.4
Test-point 30	30.0	260.0	22.8	77.2	71.5	66.1	55.5	40.3	27.9
Test-point 275	27.5	260.0	21.8	78.2	72.4	65.8	52.5	36.7	26.7
Test-point 25	25.0	260.0	20.2	79.8	73.2	63.8	49.4	35.3	25.8
Test-point 225	22.5	260.0	19.4	80.6	73.6	60.3	47.0	34.3	25.8
Test-point 20	20.0	260.0	18.6	81.4	71.6	57.6	44.7	34.3	25.0
Test-point 175	17.5	260.0	18.2	81.8	69.9	56.3	44.1	32.7	24.1
Test-point 15	15.0	260.0	19.7	80.3	67.5	54.8	42.4	31.0	22.7
Test-point 125	12.5	260.0	20.1	79.9	66.4	53.5	41.1	28.9	21.1
Test-point 10	10.0	260.0	21.1	78.9	66.4	52.3	38.6	28.0	20.4
Test-point 075	7.5	260.0	21.9	78.1	65.1	51.3	37.8	27.2	19.0
Test-point 5	5.0	260.0	22.1	77.9	64.5	49.3	37.0	26.3	19.9
Test-point 025	2.5	260.0	22.7	77.3	63.5	48.9	36.7	27.0	20.2
Test-point 0	0.0	260.0	22.8	77.2	61.7	49.0	36.9	27.3	20.4

LEOAC #_______

LEOSAT POSITION ON SERVICE AVAILABILITY RULE

o Ensuring the maximum number of licensees is an appropriate technical topic, but dictating the extent to which each licensee uses granted spectrum is not.

o Rule proposed by Orbcomm is nothing more than a short hand approach for requiring a specific number of satellites without regard to business realities.

o This is a policy decision, not a technical one. The FCC will be making a subjective opinion as to how many satellites should be launched and how quickly.

-- "Efficient use" is wholly subjective, as the comments of the parties have indicated.

-- Change in percentage of service availability has no impact on interference or number of companies that may occupy the spectrum.

-- Geostationary satellite systems are not required to provide a given percentage of service availability, business reality does this for the FCC.

o Commission imposes hours of operation rules rarely, and for policy reasons. See 47 C.F.R. 74.931. FCC will <u>limit</u> service availability to avoid interference, i.e. AM radio.

o With LEO, many plausible businesses niches could be profitable with far less than 75 percent availability; for example, home meter reading and truck positioning.

o If this is truly a technical rule, delete the word "commercial" from the proposal and apply it to all LEO licensees; otherwise recognize the idea for what it is, an attempt to impose one applicant's business plan on all others.

o Mandating a high percentage goal would mesh well with the affiliated business of one of the applicants -- providing launch services -- but would injure small companies that need to assure that a valid market exists before committing to 20 or more satellites. There would be no chance for incremental growth.

o Use of the spectrum may be a valid issue for the FCC to consider in the NPRM and each party should comment there. This matter is simply outside the purview of this committee.